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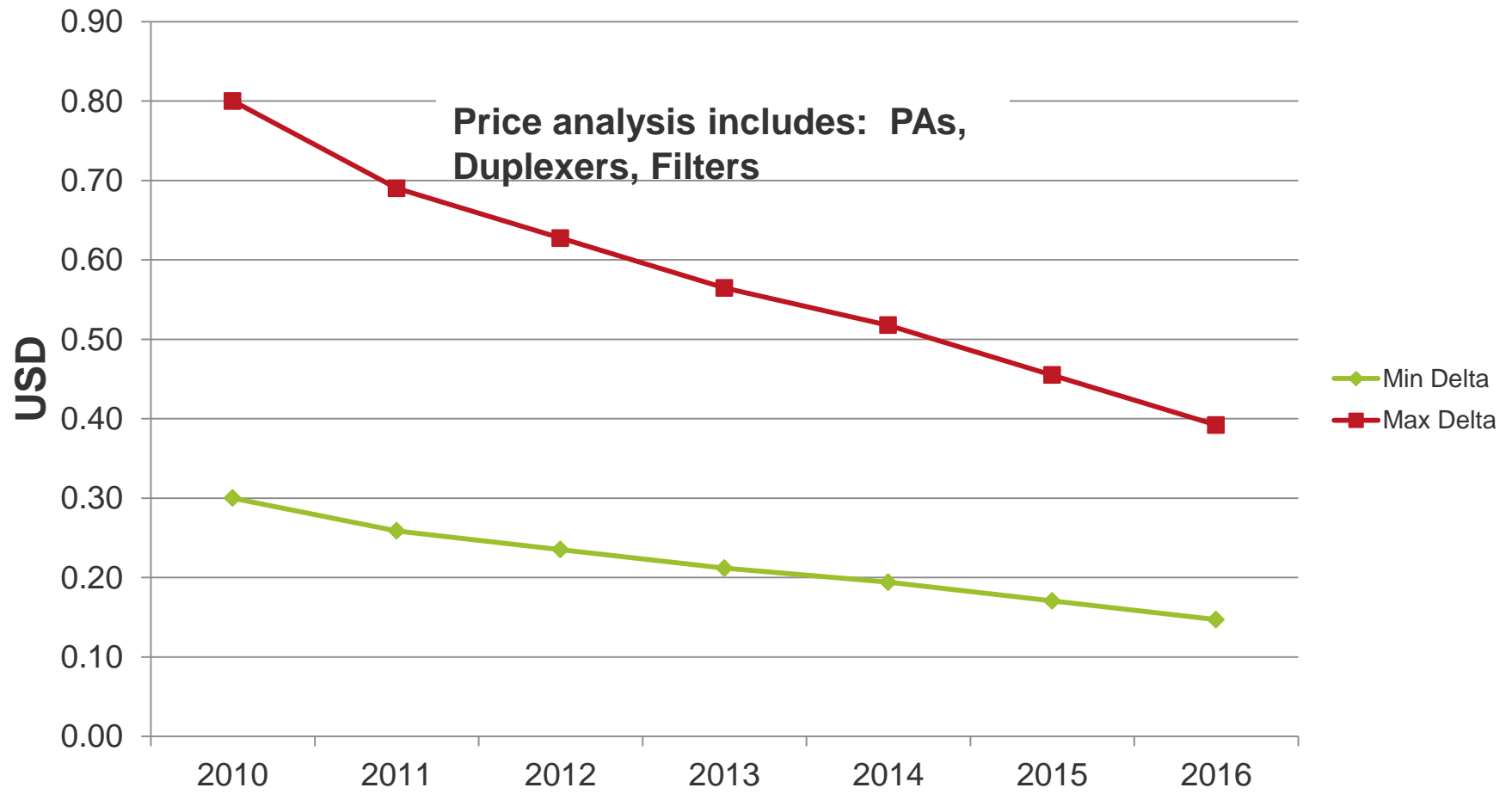
January 2013

Multiband LTE Cost Delta Analysis

Statement of Work

- ▶ The Competitive Carriers Association (CCA) wishes to educate the Federal Communications Commission on the incremental costs associated with restoring interoperability in the Lower 700 MHz by adding Band Class 12 to the device. This multiband support would enable CCA's carrier members to leverage AT&T's scope and scale with the handset OEMs.
- ▶ As such, CCA wishes to engage with IHS to provide the background data that would support its request to the FCC.
- ▶ IHS will provide the following:
 - 1) Powerpoint slides that show the cost delta between 1 band vs 2 bands of LTE support, given all other aspects of the device are equal
 - 2) An explanation of the methodology and components included in this cost delta

Band 17 vs Band 12/17



Source: IHS, Mobile Handset Cost Model

Key Assumptions

- ▶ **Assuming standard band configurations, IHS estimates that cost differences between specific bands are negligible. Material cost deltas are more driven by the number of bands if they increase the number of unique transmit and receive chains or premium multiband parts are required.**
- ▶ **Costs presented are industry average costs. Costs to specific phone models could land outside of the minimum and maximum limits based on the supplier/customer relationship and volumes factors**
- ▶ **Assumes standard, non-custom components in high volume runs.**
- ▶ **Band 12 is a superset of Band 17**
 - Whereas band 12 supports 699-716MHz on the UL and 729-746MHz on the DL
 - Band 17 only supports 704-716Mhz and 734-746MHz respectively
- ▶ **Assumes that all other aspects of the design are exactly the same aside from the components required for band support**

Key Assumptions – Continued

► Min Delta Factors

- Assumes the use of PAs capable of supporting the superset Band 12. Multiple suppliers have solutions with this capability including but not limited to:
 - Skyworks
 - RFMD
 - Anadigics
 - Avago
- Assumes availability of a Band 12 duplexer. Multiple suppliers have solutions with this capability including but not limited to:
 - Epcos
 - Murata

► Max Delta Factors

- Assumes little to no leveraging of common parts to support multiple bands
- Utilizes separate components typically in situations where the bands are in different parts of the spectrum (i.e. supporting 700MHz and the AWS band)

Key Assumptions – Continued

- ▶ ATT in the US has deployed LTE on Band 17
- ▶ MIMO is not included in this analysis and would cause cost deltas to increase at least 2 fold if not more given the increase in transmit and receive chains
- ▶ Support for RxDiversity has been taken into account in the cost ranges
- ▶ Analysis performed using the primary cost centers driving front end design for support of multiple bands
 - Power Amplifiers
 - Duplexers
 - Filters



Example Parts Supporting Band 12/17

Product	Company	Part Number	Datasheet	Notes
Power Amplifier	Anadigics	ALT6712	http://www.anadigics.com/sites/default/files/datasheets/ALT6712_Rev_2.5.pdf	
Power Amplifier	Avago	ACPM-5017		Found in the Lumia 900 and Galaxy SII
Power Amplifier	RF Micro Devices	RF7317	Listed in 2012-2013 product guide	skyrocket specific data sheet not available yet.
Power Amplifier	Skyworks	SKY77737	http://www.skyworksinc.com/uploads/documents/201803b.pdf	
Duplexer	Epcos	B7931		
Duplexer	Murata	SAYFH707MCA0F0A		

Methodology

- ▶ Holistic modeling from multiple view points
 - Supply dynamics from component, chipset and device perspective
 - Demand dynamics from mobile subscribers, cellular operators and semiconductor perspectives
 - Total market context as it relates to each device and component

- ▶ Research
 - Primary research
 - Interviews; Internal domain expertise; Equipment Teardowns
 - Secondary research
 - Financials; Releases; Public conference calls

IHS is a World Leader in Teardown Analysis

HTC OneX Teardown



- ▶ HTC OneX
- ▶ \$203.17 = Bill of Materials
- ▶ 1,169 = Number of components



Main Cost Drivers below

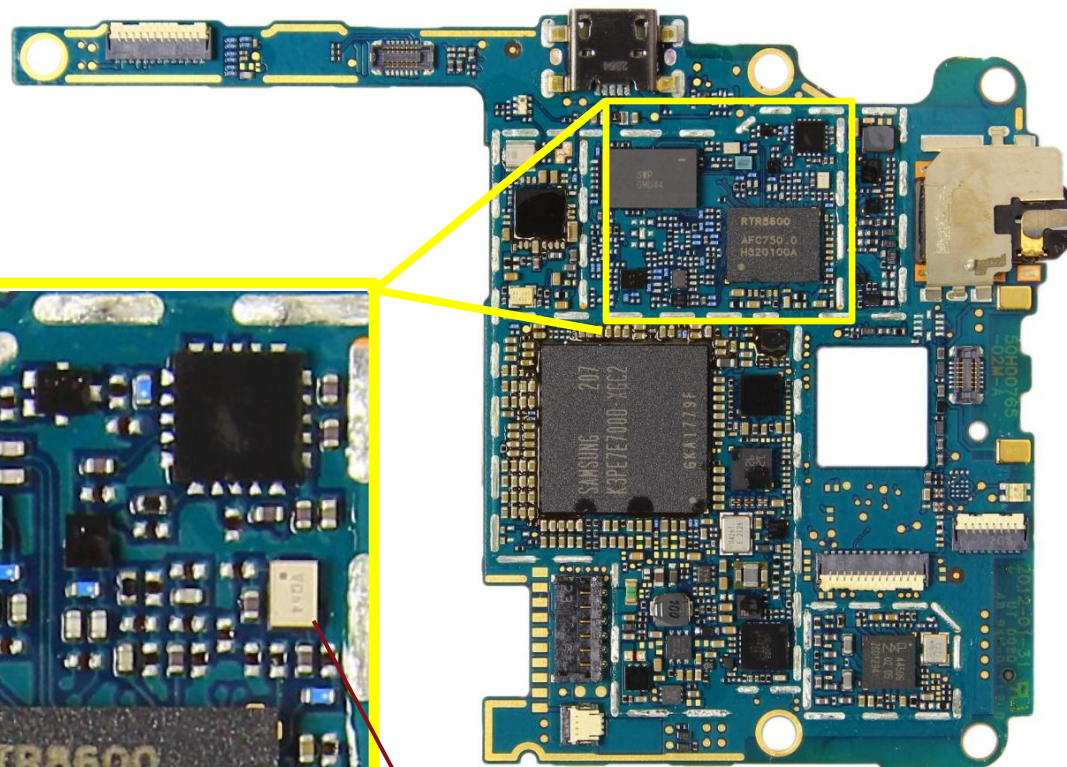
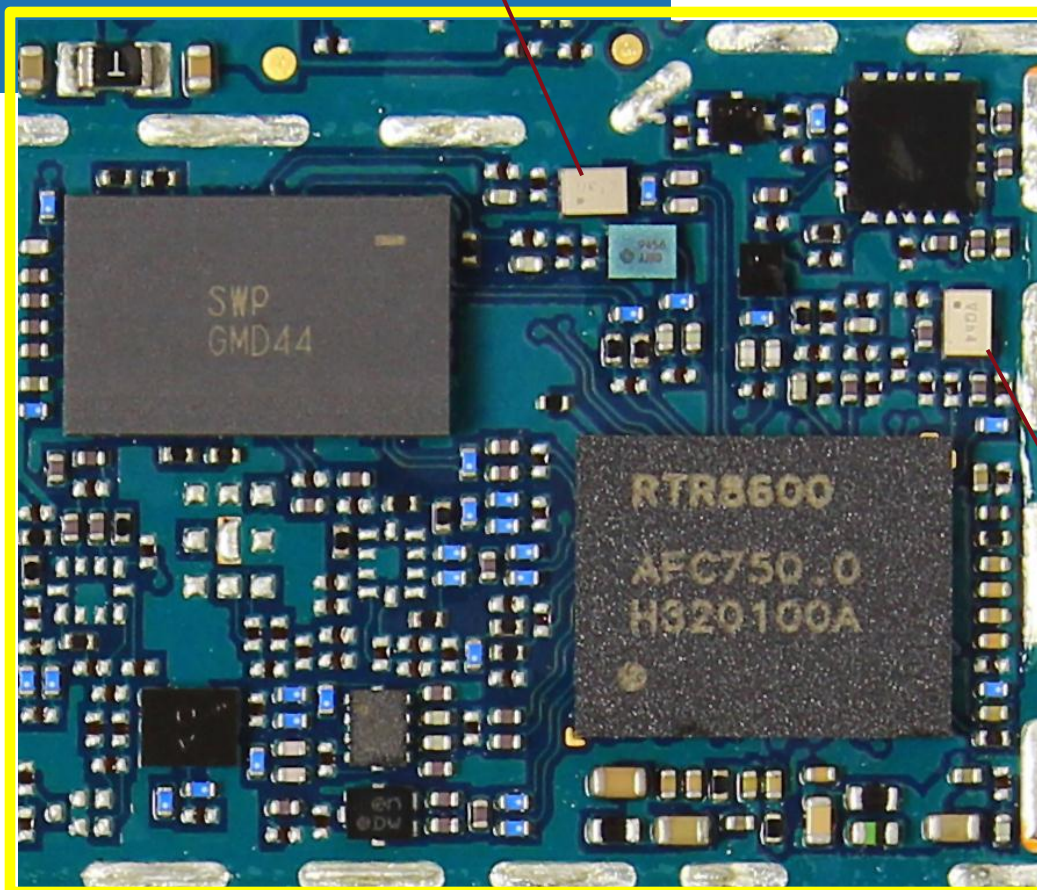
\$40 - Sharp Microelectronics LS047K1SX01K Display Module - 4.7" Diagonal, 16.7M Colors, Super LCD, 1280 x 720 Pixels, 104.1mm x 58.5mm Viewable Area, 81um x 81um Pixel Size, w/ Integral Flex PCB- (Qty: 1)
\$36.36 - Qualcomm MSM8960 Apps / Baseband Processor - Multi-Mode, Multi-Band, GSM/CDMA/EVDO RevB/HSPA+LTE, Dual-Core CPU, 1.5-1.7GHz / Core, Adreno 225 GPU, 28nm, PoP- (Qty: 1)
\$18 - Samsung Semiconductor KLMAG2GE4A-A001 Flash - eMMC NAND, 16GB, MLC- (Qty: 1)
\$16.25 - Samsung Semiconductor K3PE7E700D-XGC2 SDRAM - Mobile DDR2, 1GB, PoP- (Qty: 1)
\$14.65 - Primary Camera Module - 8MP, BSI CMOS, 1/3.2" Format, Auto Focus Lens- (Qty: 1)
\$11.5 - Touchscreen Assembly - 4.7", Capacitive, w/ Integrated Flex PCB, & 4 Plastics Light Pipe- (Qty: 1)
\$5.18 - Unitech 10-Layer - FR4/RCF HDI, Any Layer Stacked Via, Lead-Free, Halogen-Free- (Qty: 1)
\$5.08 - Qualcomm RTR8600 RF Transceiver - Quad-Band GSM/EDGE, Quint-Band UMTS/HSPA/LTE, 1.8GHz Processing- (Qty: 1)
\$4.22 - Qualcomm PM8921 Power Management IC- (Qty: 1)
\$4.15 - BJ83100 Battery - Li-Polymer, 3.7V, 1800mAh, 6.6Whr- (Qty: 1)

Model #	Function	Component Family	Manufacturer Name	Manufacturer Part Number	Component Description	HW Cost	Data Sheet Links
HTC One X (ATT)	RF / PA	Integrated Circuit	Skyworks	SKY77707-3	PAM - LTE Band 12/17, 698-716MHz	\$0.60	http://www.skyworksincl.com/uploads/documents/201218a.pdf
HTC One X (ATT)	RF / PA	Passive	Taiyo Yuden	FAR-D5NE-740M00-P1C9	Duplexer - LTE Band 17, 710/740MHz	\$0.39	http://www.yuden.co.jp/productdata/sheet/P1C9.pdf
HTC One X (ATT)	RF / PA	Passive	Taiyo Yuden	FAR-F5K7-740M00-B4UR	RX RF SAW Filter - LTE Band 17, 740MHz	\$0.10	http://www.yuden.co.jp/productdata/sheet/B4UR.pdf
HTC One X (ATT)	RF / PA	Passive	Taiyo Yuden	FAR-F5KA-710M00-D4VQ	TX RF SAW Filter - LTE Band 17, 710MHz	\$0.10	http://www.yuden.co.jp/productdata/sheet/D4VQ.pdf
					As of June 2012	\$0.58	

HTC One X (ATT)

LTE Band 17 Components - Main PCB, Top

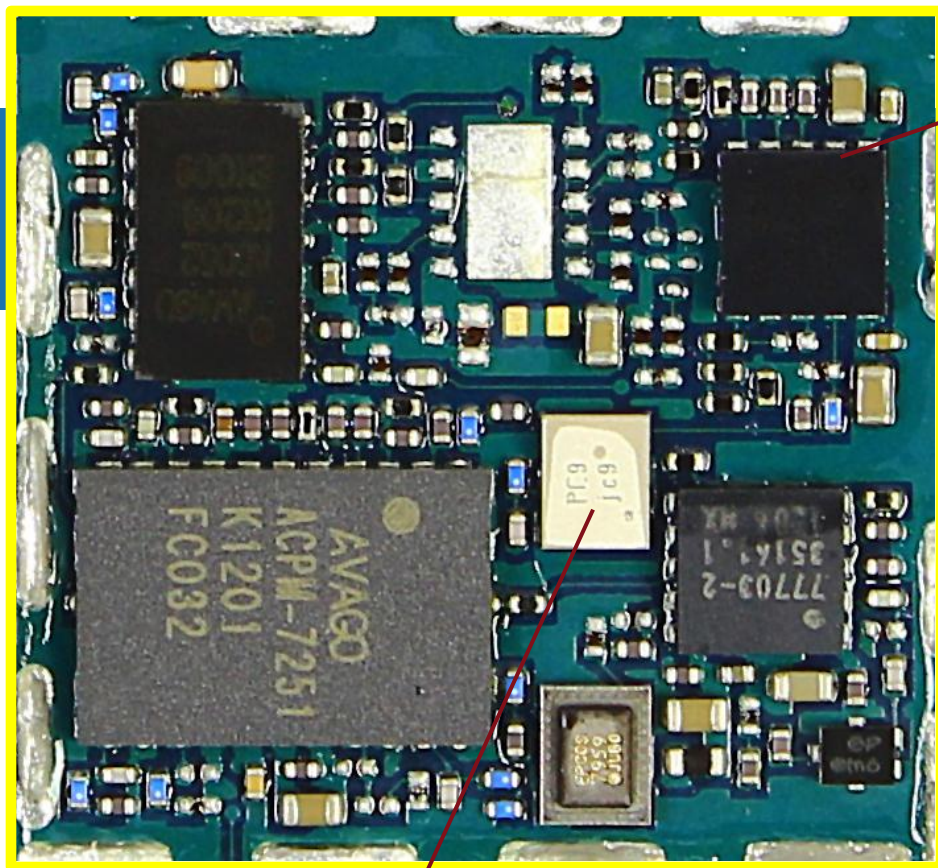
Taiyo Yuden
FAR-F5K7-740M00-B4UR



Taiyo Yuden
FAR-F5KA-710M00-D4VQ
TX RF SAW Filter - LTE Band 17,
710MHz

HTC One X (ATT)

LTE Band 17 Components – Main PCB, Bottom



Taiyo Yuden
FAR-D5NE-740M00-P1C9
Duplexer - LTE Band 17

Skyworks

